

## ON THE SEASONAL ABUNDANCE OF YOUNG FISH. VI. THE YEAR 1938

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(Text-figs. 1-3)

The present report continues the series of observations on the seasonal abundance of the pelagic young of teleostean fish in the plankton off Plymouth (Russell, 1938*b*), and gives the results for the year 1938. These results are published in the same form as in previous reports. The dates on which collections were made with the 2 m. stramin ringtrawl are given in Table I, and the monthly average catches of the young fish per half-hour oblique haul in Table II. In Fig. 1 is given the curve for the average catches for each

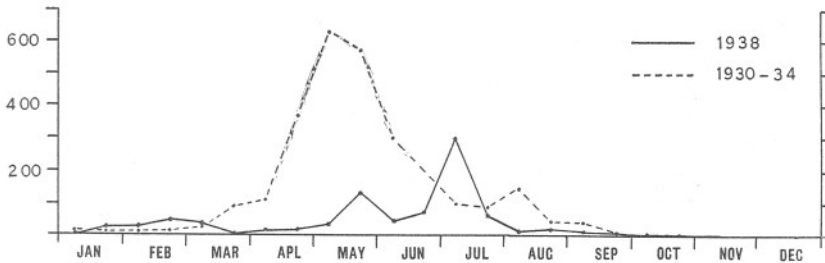


Fig. 1. Curves showing the average catches in half-hour oblique hauls with the 2 m. ringtrawl for each fortnight for all young fish, excluding clupeids, in 1938 (—) and the same averaged over the period 1930-4 inclusive (-----).

fortnight of all young fish, excluding clupeids, and superimposed upon this the corresponding curve for the average catches over the period 1930-4 inclusive.

The results are practically a repetition of those for 1936 and 1937. The complete absence of the peak for the young of spring spawners was repeated in 1938, and if anything their numbers were even lower than in the two previous years. The sum of the monthly average catches of those post-larvae which show maximal abundance in the months June to October inclusive, excluding clupeids, was 135 in 1938, as against 174 in 1937 and 115 in 1936. The 1938 figures should perhaps have been slightly lower as they were heavily weighted by one exceptionally heavy catch on July 5. The numbers in this catch were rather remarkable, there being 2525 clupeids and 502 other fish, while the remaining July catches gave figures of 180, 94, and 80 for all fish including clupeids. There were no *Sagitta elegans* in the catch on July 5,

nor were there any indications from the plankton that the water might have been of different origin on that day as compared with other weeks in June and July. But the whole plankton catch was itself unusually large on July 5 and we can only conclude that the plankton had been collected together by some unusual condition of tidal or other currents. Lest this anomaly should cast doubt on the general picture based on these single weekly hauls it should be pointed out that during each week ringtrawl collections are made for other purposes. These collections have always confirmed the results of the routine observations.

The general poverty of young fish in 1938 again shows correlation with the low phosphorus content of the water in the previous winter, which was -16% below the mean (Cooper, 1938, p. 187).

The sums of the average monthly catches of the more important species for the year 1938 divided by the corresponding average sums for the period 1930-4 inclusive are given below. In the second column are the figures for the best year divided by the worst year from 1930 to 1938 inclusive.

	1938 Av. 1930-4	Best Worst
<i>G. merlangus</i>	0.08	23.6 (32/36)
<i>G. minutus</i>	0.13	40.3 (32/36)
<i>Onos</i> spp.	1.21	13.0 (30/35)
<i>Arnoglossus</i> sp.	0.51	11.5 (31/34)
<i>S. norvegicus</i>	0.05	28.7 (32/38)
<i>P. limanda</i>	0.24	14.0 (31/35)
<i>P. microcephalus</i>	< 0.04	> 41.0 (32/38)
<i>S. variegata</i>	0.20	7.6 (32/38)
<i>Callionymus</i> sp.	0.14	7.7 (30/38)
<i>S. scombrus</i>	1.54	11.2 (30/35)
Gobiid sp.	0.05	119.0 (30/37)

The year 1938 has thus been the worst during the period 1930-8 for *S. norvegicus*, *S. variegata*, and *Callionymus*.

The decrease in the numbers of *Callionymus*, which was commented on in the report for the year 1937, has been continued, these having fallen from an average of 548 for the period 1930-4 to only 76 in 1938. The first column in the above table shows very clearly the decrease in the numbers of those species which were of considerable importance in the young fish population in the years 1930 to 1934. Except for *Onos*, *Arnoglossus*, and *Scomber*, all species are now less than one-quarter as numerous as they were in the period 1930-4, and, of these, half have been reduced to less than one-tenth.

If the number of young of summer spawners (135) be subtracted from the total young fish (450), we are left with 315 for the remaining young fish most of which are the young of spring spawners. This is the lowest number yet

recorded and is less than one-quarter of the 1395 specimens recorded in 1931.

There are indications that this decline in production is now being shown in the stocks of adult fish.

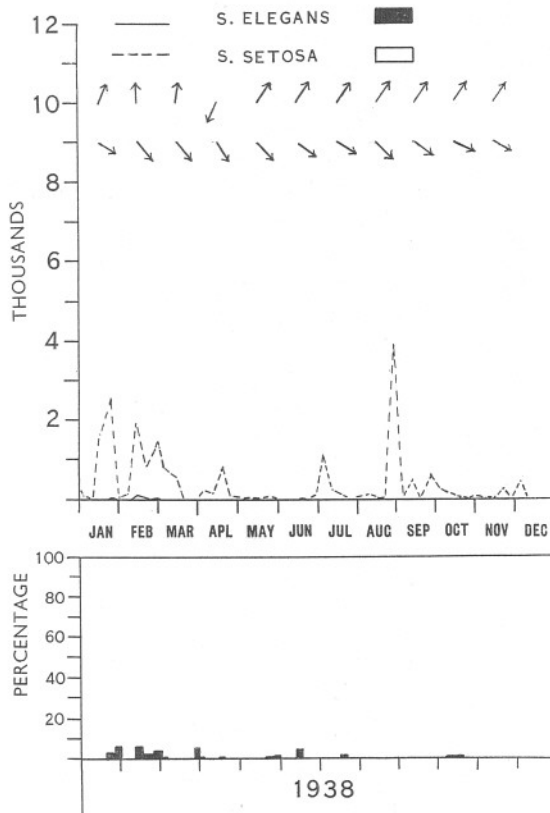


Fig. 2. Above, curves showing the actual abundance of *Sagitta elegans* (—) and *S. setosa* (-----) in half-hour oblique hauls with the 2 m. ringtrawl during the year 1938. Below, the percentage composition of the *Sagitta* populations during the same period: *S. elegans*, black; *S. setosa*, white. At the top of the diagram the arrows indicate the mean directions (true) of the flow of water past the Varne Lightship (above) and the Royal Sovereign Lightship (below) from data kindly supplied by Dr J. N. Carruthers.

As regards the plankton the conditions during 1938 were exceptional (Figs. 2, 3). There has been an almost complete absence of *Sagitta elegans*, and *S. setosa* has predominated since August 1937. This is the longest consecutive period that there has been of this nature since detailed observations were started in 1930. At the same time the numbers of *S. setosa* have been unusually low, and there has been a marked scarcity of plankton animals of all kinds in the ringtrawl catches. The total number of medusae of all species,

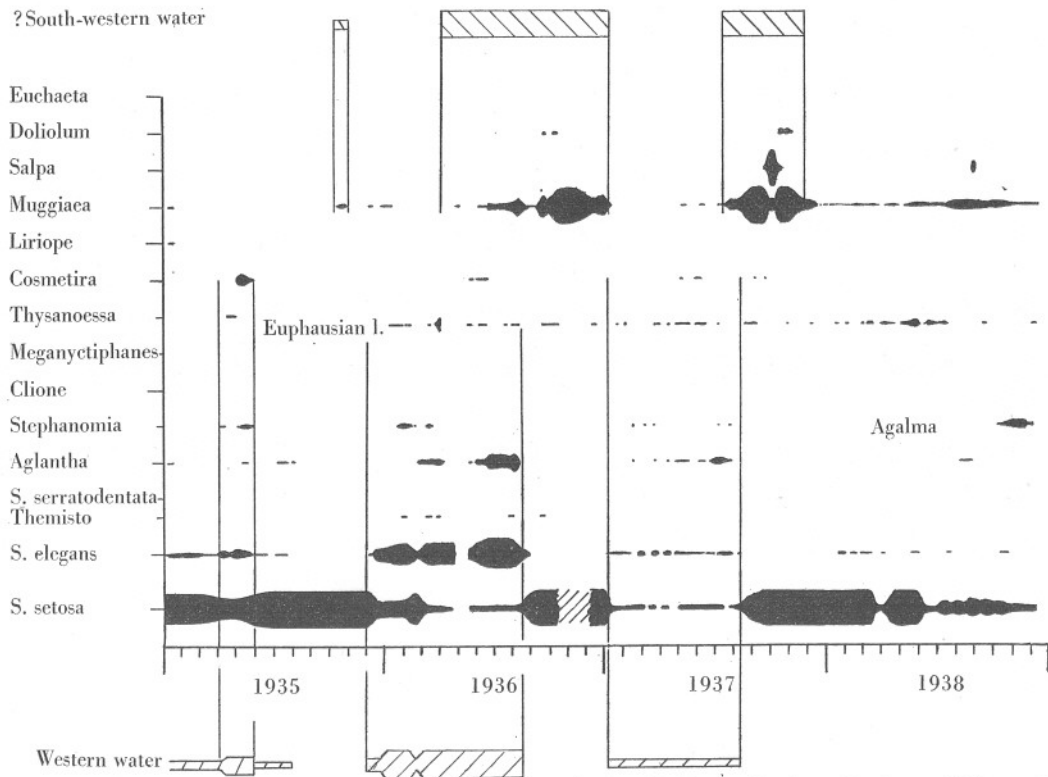


Fig. 3. Diagram showing the occurrence of the various plankton indicators in the collections off Plymouth during the years 1935 to 1938 inclusive. (Continued from Russell, 1938*b*, p. 497, Fig. 4.) The *Muggiaca* species were *M. kochi* up to January 1937, and thereafter *M. atlantica*, the salps were *S. fusiformis*, and the doliolids *D. nationalis*.

for instance, was only 2111. This is the lowest for any year since records started in 1930 (Russell, 1938a). It is interesting to record that the siphonophore *Agalma elegans* appeared in the catches in October and remained until the beginning of December. This is the first time that this species has been recorded from Plymouth. The species has not been accompanied by *Sagitta elegans* and it seems probable that it has been brought into the area by wind-driven surface water. It is also noteworthy that *Muggiaea atlantica* has occurred in the catches in every month of the year, although in rather low numbers.

The occurrence of many pilchard eggs was again a prominent feature. They were present from April to December, their approximate numbers, in the catches in which they occurred, being as follows. April 4 (60), 11 (160), 19 (1240), 24 (1220); May 2 (8910), 9 (3300), 17 (1700), 23 (920), 30 (1580); June 7 (2280), 14 (5540), 21 (14,120), 28 (18,180); July 5 (28,340), 11 (1380), 18 (3580), 21 (2860); August 8 (1400), 22 (30); September 6 (20), 12 (630), 19 (680), 27 (1760); October 3 (960), 10 (870), 17 (60), 25 (480); November 1 (310), 7 (1920), 14 (10), 28 (1); December 5 (1).

The pilchard eggs occurred almost to the exclusion of the eggs of other fish during this period.

REFERENCES

COOPER, L. H. N., 1938. Phosphate in the English Channel, 1933-8, with a comparison with earlier years, 1916 and 1923-32. *Journ. Mar. Biol. Assoc.*, Vol. XXIII, pp. 181-95.  
 RUSSELL, F. S., 1938a. The Plymouth offshore medusa fauna. *Journ. Mar. Biol. Assoc.*, Vol. XXIII, pp. 411-40.  
 — 1938b. On the seasonal abundance of young fish. V. The year 1937. *Journ. Mar. Biol. Assoc.*, Vol. XXIII, pp. 493-500.

TABLE I. DATES ON WHICH COLLECTIONS WERE MADE, 1938

All 2 miles east of Eddystone unless otherwise stated

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	7	4*	4	2	7	5	8	6	3	1	5
10†	14	14	11	9*	14	11	15	12	10	7	9‡
17	21	18	19	17§	21	18	22	19	17	14	..
25	28	23	24	23	28*	21	29	27	25	21	..
31*	..	28	..	30	..	..	..	..	..	28	..

\* L 4-L 5.

† Off Rame Head.

‡ L 3-L 4.

§ 4 miles W.S.W. of Rame Head.

|| West of Rame Head.

TABLE II. MONTHLY AVERAGE CATCHES OF POST-LARVAE PER HALF-HOUR

Oblique hauls with 2-m. ringtrawl, 1938

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Σ
Total young fish	24	107	22	23	149	169	845	27	12	10	11	1	1400
Ditto, less Clupeids	14	38	18	16	94	62	182	16	8	2	+	..	450
All Clupeid spp.	9	69	4	7	55	107	663	11	4	8	10	1	948
<i>Clupea harengus</i>	1	..	..	..	..	..	..	..	..	..	..	..	1
<i>Gadus pollachius</i>	..	1	..	+	3	+	..	..	..	..	..	..	4
<i>Gadus merlangus</i>	..	3	+	2	4	7	+	..	..	..	..	..	16
<i>Gadus minutus</i>	..	7	..	5	+	..	..	..	..	..	..	..	12
<i>Gadus luscus</i>	3	7	..	..	..	+	+	+	..	+	..	..	10
<i>Gadus callarius</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Onos</i> spp.	..	..	..	+	56	4	3	+	..	..	..	..	63
<i>Molva molva</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Merluccius merluccius</i>	..	..	..	..	..	..	..	+	..	..	..	..	+
<i>Raniceps raninus</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Capros aper</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Zeus faber</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Arnoglossus</i> sp.	..	..	..	..	..	+	14	2	1	+	..	..	17
<i>Rhombus laevis</i>	..	..	..	..	+	..	..	..	..	..	..	..	+
<i>Rhombus maximus</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Scophthalmus norvegicus</i>	..	..	..	+	1	1	1	+	..	..	..	..	3
<i>Zeugopterus punctatus</i>	..	..	..	..	..	..	+	..	..	..	..	..	+
<i>Zeugopterus unimaculatus</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Pleuronectes limanda</i>	..	..	..	2	10	1	+	..	..	..	..	..	13
<i>Pleuronectes flesus</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Pleuronectes microcephalus</i>	..	..	..	..	+	..	+	..	..	..	..	..	+
<i>Solea vulgaris</i>	..	1	+	1	+	..	..	..	..	..	..	..	2
<i>Solea variegata</i>	..	..	..	1	1	3	12	..	..	..	..	..	17
<i>Solea lascaris</i>	..	..	..	..	..	..	+	..	+	..	..	..	+
<i>Solea lutea</i>	..	..	..	..	..	1	..	..	..	..	..	..	1
<i>Serranus cabrilla</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Caranx trachurus</i>	..	..	..	..	..	..	..	4	4	+	..	..	8
<i>Mullus surmulletus</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Morone labrax</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Ammodytes</i> sp.	12	19	16	1	1	5	5	+	1	1	..	..	57
<i>Ammodytes lanceolatus</i>	..	..	..	2	3	5	27	2	..	..	..	..	39
<i>Cepola rubescens</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Callionymus</i> sp.	..	..	..	3	13	18	38	3	1	+	..	..	76
<i>Labrus bergylta</i>	..	..	..	..	..	2	2	..	..	..	..	..	4
<i>Labrus mixtus</i>	..	..	..	..	..	..	1	..	..	..	..	..	1
<i>Ctenolabrus rupestris</i>	..	..	..	..	..	4	13	+	..	..	..	..	17
<i>Crenilabrus melops</i>	..	..	..	..	..	1	3	..	..	..	..	..	4
<i>Centrolabrus exoletus</i>	..	..	..	..	..	..	+	..	..	..	..	..	+
<i>Trachinus vipera</i>	..	..	..	..	..	..	1	+	+	..	..	..	1
<i>Scomber scombrus</i>	..	..	..	..	..	7	26	1	..	..	..	..	34
<i>Gobius</i> spp.	..	..	..	..	+	..	2	..	..	..	..	..	2
<i>Lebetus scorpioides</i>	..	..	..	..	..	+	+	..	..	+	..	..	+
<i>Blennius ocellaris</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Blennius pholis</i>	..	..	..	..	..	2	1	..	..	..	..	..	3
<i>Blennius gattorugine</i>	..	..	..	..	..	7	31	2	1	..	..	..	41
<i>Chirolophus galerita</i>	..	1	+	..	..	..	..	..	..	..	..	..	1
<i>Agonus cataphractus</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Trigla</i> spp.	..	..	..	..	1	..	1	..	..	..	..	..	2
<i>Cottus</i> spp.	..	1	1	1	..	..	..	..	..	..	..	..	3
<i>Liparis montagui</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Lepadogaster bimaculatus</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Lophius piscatorius</i>	..	..	..	..	..	..	..	..	..	..	..	..	..
Pipe fish	..	..	..	..	..	..	..	..	..	..	+	..	+